Relative Toxicological Effects of Synthetic Ethanol and Grain Fermentation Ethanol in Blended Whiskies

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SINCE the repeal of the 18th Amendment to the Constitution and the legalizing of the use of alcoholic liquors, the question of blended whiskey has again aroused interest. Prior to the advent of prohibition, the alcohol used in the preparation of blended whiskies was produced largely through the fermentation of grain-mash. Smaller amounts were produced by the fermentation of blackstrap molasses. Today, the most economical source of fermentation alcohol is probably molasses. The synthesis of ethyl alcohol from ethylene has been known to organic chemists for a long time, but this process has only quite recently been developed on a technical scale of production, utilizing the gases resulting from the "cracking" of petroleum. The ethylene from this source is combined with sulphuric acid to form ethyl sulphuric acid. This, in turn, is hydrolized with alkali to produce ethyl alcohol. This synthetic alcohol is now obtainable in large quantities in a very high degree of purity, at prices which compare quite favorably with fermentation alcohol.

These studies were undertaken to determine whether there was any detectable difference in the intoxicating or toxic properties of alcohol produced by grain fermentation and that synthesized from hydrocarbons, and, furthermore, to compare their effects when used in blending whiskies.

TESTS OF COMPARATIVE EFFECTS OF SYNTHETIC AND FERMENTATION ALCOHOL

The samples of alcohol employed were purchased on the open market and were found to correspond to the requirements of the United States Pharmacopoeia. The fermentation alcohol was stated by the manufacturer to have been prepared from grain. It contained 94.94 per cent ethyl alcohol and 5.06 per cent water, by volume. The synthetic product contained 95 per cent ethyl alcohol and 5 per cent water, by volume. When the U.S.P. tests were applied, both specimens gave negative reactions for fusel oil constituents, acetone, methanol, and aldehyde. It can be stated from the chemical tests that these were both samples of the constant boiling mixture of ethanol and water, which constitutes the common 95 per cent alcohol employed in pharmacy.

Animal experiments on alcohol from these two sources have been conducted in other laboratories and will be reported elsewhere. The tests reported herein were made entirely upon humans. Fifteen male subjects were employed. They ranged from 22 to 51 years of age. Of these, 6 were medical students,

4 were engaged in light labor, and 5 in heavy labor. They were classified on the basis of previous experience with intoxicating liquors, as (1) abstainers, (2) moderate drinkers, and (3) heavy drinkers. Subjects were required to abstain from all alcoholic beverages during the 48 hours preceding the test, and to report early in the morning without having eaten breakfast.

The dose of alcohol was gauged according to the weight of the subject and the reported previous experience with alcohol. Abstainers were given 0.5 c.c. absolute alcohol per kg. body weight, moderate drinkers received 1.0 c.c. per kg., and heavy drinkers received 1.5 c.c. per kg. In each case, the alcohol was diluted to 10 per cent strength with cool water. The subject was required to drink one-tenth of this diluted dose during each 3 minutes over a 30 minute interval.

Two tests were conducted upon each subject—one employing diluted fermentation alcohol and the other using synthetic alcohol. The bladder was emptied at the start of the experiment to furnish a control specimen of urine. Urine specimens were collected at 45, 90, 120, 180, and 240 minutes after completely drinking the alcohol dose. Subjective symptoms, as well as objective observations of alcoholic intoxication or any of the accompanying complicating factors such as nausea, headache, etc., were noted during the period following the drinking.

On the doses employed, the subjects reached varying stages of intoxication, ranging from a feeling of fullness in the head to a drunken stupor. The peak of the objective response, as well as the maximum concentration of alcohol in the urine, was reached at about 45 minutes after completion of the drinking. The average maximum concentrations of alcohol of the urine were 0.9 mg. per c.c. for the group of abstainers, 1.25 mg. per c.c. for the group of moderate drinkers, and 1.65 mg. per c.c. for the group of heavy drinkers. In duplicate experiments, no real difference could be observed between the response to ethanol from the two sources (grain fermentation and synthetic).

EXPERIMENTS ON THE EFFECTS OF 4 YEAR OLD KENTUCKY BOURBON WHISKY BLENDED WITH 50 PER CENT ALCOHOL

Specimens of Kentucky Bourbon whisky (aged 4 years) were blended by expert blenders using in one instance 50 per cent grain fermentation alcohol and in the other instance synthetic alcohol. The blended products were adjusted to a final alcohol content at 50 per cent by volume (100 proof). So far as fusel oil content, aldehydes, esters, and acidity were concerned, the content of both blended whiskies were much lower than the straight bourbon whiskey which was used. The analyses of the two blended whiskies were essentially the same.

Employing the same 15 human subjects used in the alcohol tests, similar experiments were conducted using these two blended whiskies. In calculating the dose for each individual subject, the amount of whiskey necessary to give a maximum urine concentration of 1.5 mg. alcohol per c.c. was estimated. In this way an attempt was made to rule out individual susceptibility to alcohol and to make all the subjects equally intoxicated. Based upon previous experience in the alcohol tests, this result was fairly well approximated. The various subjects all became quite intoxicated, although they varied materially in the manner in which this intoxication became manifest. Some became drowsy and fell asleep; others became sullen and morose; others were emotionally excited with fits of hilarity, singing, weeping or combativeness. Observations were made to note any differences between the two whisky

blends in each of the subjects—not only with respect to the acute effects but also for any material differences in the chronic effects ("hangover") such as headache, nausea, etc. So far as could be determined, the effects of the two blended whiskies were identical.

SUMMARY

The effects of drinking diluted ethyl alcohol from two sources, (1) grain fermentation, and (2) synthesis from ethylene, have been studied in 15 human subjects. Alcohol from these two sources blended with 50 per cent of 4 year old Kentucky Bourbon whiskey to give 100 proof blends, have been studied in same series of subjects. No difference in intoxicating effect nor in immediate after-effects ("hangover") could be noted in the effects of the alcohols nor in the whisky blends prepared from them. In their effect upon the human, synthetic ethyl alcohol is identical with ethyl alcohol produced from the fermentation of grain.

What Is Public Health?

IS not public health merely a matter of water supplies, ventilation, sewage, clinics, drains, street cleaning, garbage, infectious diseases, public health nurses, flies, dirt, slums, and serums? True it is that these items are all in it. But they no more constitute public health than mere paint, canvas, and brushes constitute art; or mere iron ore and smelters constitute architecture; or rods, lines, and nets constitute the fishing industry; or axes and wire rope constitute lumbering; or schoolhouses and textbooks constitute education. All these items are merely the tools of the arts. The tools of an art are essential to the art; but they do not constitute the art. Art is the result achieved; it is that object toward which tools merely perform the shaping of the path. . . .

That public health originated in the attempt to relieve crude physical suffering and especially to achieve this only by preventing disease, does not take from its present or future immensely greater importance. That it has reached already its present outstanding influence is proof enough of its inherent strength, a strength derived wholly from its truth—that is, its correspondence with, not things just dreamed about, but things that are—not with just some things in the universe but with all things. . . .

The common objective of medicine and of public health is the reduction of human misery due to disease and death. The one devoted itself to the relief and cure of those already suffering, the other to prevention. Since neither fully succeeds, each must continue to supplement the other. Each in its own field has made enormous advances from each its own angle. Coöperation is increasing as each—medicine and public health—understands the other's problems better.—H. W. Hill, M.D., *Weekly Bull.*, Albany, N. Y., Aug. 8, 1935.